

# NORTHEASTERN FOREST EXPERIMENT STATION

## Division of Watershed Management Research

Semi-annual Report

April 1955

### GENERAL

It will be no surprise to our readers that these unsigned reports do not magically appear on our desk April 1, full-bodied with accounts of the past 6 months, and ready for the outgoing basket. Never happens. They're the work--largely unexpurgated--of several who, for this one time at least, will receive due credit. Irv Reigner, unaided, writes the Kingston copy with a scrub-oak quill. Dick Trimble is responsible for the report from the White Pine-Hardwood Research Center. Everything's new up there: Dick uses a ball-point. Sid Weitzman, wearing his influences hat, composes the Mountain State offering. The miserable introduction is Lull's work:

#### New soil moisture measurer

Reigner and Lull visited Seabrook Farms recently and were treated to a glimpse of the latest in soil-moisture measuring instruments, and a tour of the well-known recharge area. The soil-moisture instrument is the commercial version of the portable slow neutron flux meter described by Underwood et al in Soil Science 77: 339, 1954. Now called a "neutron moisture scanner", this instrument is manufactured and sold by William B. Johnson and Associates, Empire State Building, New York 1, New York. Its cost, including the neutron source, is about \$1400.00. The instrument, weighing 13 pounds, is a "self-contained battery powered unit, ruggedized for use, which may be calibrated to give direct moisture readings in percent by volume, for both surface and depth type measurements". According to the maker, it requires but one calibration for all soil types, and moisture content value can be obtained for about a 6-inch soil layer in 2 to 3 minutes. For details and photos of the instrument, write Mr. Johnson.

#### Seabrook recharge

Dr. Irwin Remson of the Geological Survey took us over the recharge area described in the recent mimeo release from the Washington Office. According to this release, one of the major questions to be settled was why infiltration was so much greater in the woodland than in the clover field where recharge was not possible. The answer, according to Remson, was that the clover field possessed a very evident plowsole which limited infiltration.

The most striking features of the two recharge zones we visited were the dead trees, debarked by streams of water from the high pressure nozzles; the change in ground cover from Vaccinaceous species to a dense cover of poke-weed and elderberry, and in one zone, grass; and the formation of a 2 to 3-inch mull containing organic fragments from the waste water.

This area will continue to be used for recharge. From our observations, much of the woodland is dead. The high infiltration rates can be ascribed to the protection the ground cover offers, the type of soil--a permeable sand, and most important, the undisturbed condition of the soil.

Dr. Remson has prepared several papers describing results of his studies in this area. Two of his papers will be published shortly in the Transactions, AGU.

#### KINGSTON RESEARCH CENTER

Howard Lull, our new Division Chief, has spent considerable time with us since the last report. Besides, familiarizing himself with the Dilldown and Pocono projects and getting involved in our numerous problems, Howard now has a speaking acquaintance with real scrub oak and a stumbling acquaintance with the rocky terrain at the Pocono Forest.

#### Precipitation, Stream flow and Water Loss

By a slight amount, water year 1953-54 was the driest yet measured at the Dilldown Watershed. Total precipitation was 45.03 inches, compared to 45.12 inches in 1949-50.

We anticipated a low annual runoff, but did not expect it to be so drastically low--only 20.81 inches. This was nearly 5 inches less than the previous low of 25.41 inches in water year 1948-49.

This is the first year in which water loss exceeded 50 percent at the Dilldown Watershed. The high water loss, percentage wise, was apparently the result of rainfall distribution. We hope, anyway, that it was not caused by increased water use by the vegetation during this calibration period.

#### Watershed Calibration

Measurements at the Dilldown Watershed are now in the seventh water year. Certainly it is high time to begin analysis to find out if the present data are sufficient to consider the watershed calibrated with its present scrub oak cover.

As far as we know, the standardization of a watershed on itself for water yield comparisons has never been fully tried. Heretofore, watershed treatment effects have been mostly determined by comparisons with a control watershed. At the Dilldown Watershed, for which there is no control, relationships with climatic factors set up during "control" period will be used for comparison with relationships determined after treatment.

Lull and Reigner are about to embark on the process of determining if these "control" relationships are now adequately defined. It is expected that aid and assistance may be needed from Kovner, at Coweeta, who has been developing useful techniques.

#### Snow, Lack Of

One of the several facets of the water regime that was expected to be affected by watershed treatment of the Delaware-Lehigh Experimental Forest was the depth of the snow pack and its duration or rate of melting. Obviously, a change in watershed cover from low brush to high forest should result

in a different amount of snow interception; also, the increased shading should hold the snow pack longer. And certainly, snow would be important and plentiful--the old-timers of the area said so!

We now wonder where all the snow has gone. Into the next county? Are we in a warm cycle, or has the slight warming of the climate reduced the snowfall? Or were the old-timers guilty of believing their own exaggerations? Anyway, in seven winters the snow pack has been shallow, intermittent, often incomplete and altogether unimportant.

Until this year, we assumed the winters were warmer than normal and that this abnormality was reflected in the snowfall. But this winter has not been warmer than normal--it's been a dinger. Nevertheless, the snowfall has been less than ever. Not once has the snow been deep enough or lasted long enough to warrant a snow course measurement. Perhaps we just haven't sampled enough winters.

### Scrub Oak Conversion

The final draft of a plan to convert the vegetation on the Dilldown Watershed from scrub oak brush to high forest is nearing completion. It will then be presented to the Pennsylvania Department of Forests and Waters for their consideration.

The installation of permanent photo plots on the Dilldown Watershed began in October. Two plots are being located in each of the 16 categories of vegetative cover on the watershed. Photographs in black and white and Kodachrome are being taken at each plot. Plans are to rephoto these plots at 5-year intervals.

Another phase of the chemical release study was completed on November 1. A water emulsion was applied for comparison with the usual 2,4,5-T in oil. All went well until the hose blew off the pressure sprayer--good subject for slapstick comedy. Very disconcerting. Not all the solution was lost--we had enough to finish the job adequately.

### Chemical Site Treatment

It is becoming obvious that seedlings planted in the untreated brush are growing with less vigor than those planted on treated areas. Comparing similar plantings made in furrows, in an area treated with Ammate, and in an adjacent untreated area, red, jack, and pitch pine seedlings show greater growth in the treated areas. As the ammate treatment did not kill the scrub oak (as it was supposed to) but did kill much of the herbaceous ground cover, it appears that the latter may be the limiting factor.

Considering the dense root mat it forms in the humus layer and upper A<sub>2</sub> horizon, it is easy to visualize that the low ground cover, blueberry, sheep laurel, etc., may compete seriously for moisture with the planted stock. Accordingly, a study has been devised to prepare planting spots by killing the ground cover with herbicides. Various herbicides and concentrations will be tried on spots 18 to 24 inches in diameter. The spots will be planted in spring. Any residual toxicity will soon be evident and the

effect of the site treatment on growth will be measured in several years. A work plan was prepared in December. Suitable weather for spraying did not occur until March 10 and 11.

Our chief concern now is how to find the spots. Had the spots been prepared in the fall, the dead vegetation would be visible without difficulty; and the spots will be visible in the spring of 1956. But there is some question about their visibility about 6 weeks after spraying.

### Publications

Tables are being prepared and writing is underway for the third Dilldown Report. Previous reports were published by the Pennsylvania Department of Forests and Waters in 1951 and 1953. The compilations represent a sizeable job, but the publication should be ready for review by June.

This report will include very little new material other than the data tables. Reigner will discuss the hydrology phases of the project during the two-year period and will collaborate with McNamara and McQuilkin in discussing scrub oak conversion results to date. Lull will write the introduction.

Reigner has prepared a detailed handbook of field procedures for obtaining hydrologic data at the Dilldown Watershed and another for the watershed project at the Pocono Experimental Forest. After review by Dixon Miller, the resident hydrographer at Dilldown, revisions are now being made for the final draft. Other handbooks are to be prepared for office procedures and for maintenance of hydrologic instruments.

### Infiltration Project

With the advent of Spring, the Northeast Extension of the Vicksburg Infiltration Project has removed its truck from winter storage and started the spring sampling schedule. This schedule consists of three sampling rounds of all the sites.

Ralph Moyle, Beryl Jones, and Art Eschner completed five sampling rounds before the middle of November. The time from the last fall sampling to the first sampling in the spring was consumed in the office working on collected data. It might be interesting to note the accomplishments of the five sampling rounds. They consist of approximately 25,000 man miles travelled, 22,500 soil strength measurements, 2,250 soil moisture values, and 1,080 bulk density measurements. In the office, saturation and 60 cm tension values were obtained from the bulk density cores; and trial predictions ran at each site for the period of sampling.

The Soil Conservation Service has been very cooperative in obtaining the correct names for the different soils. To date, the soils in Pennsylvania have been named, and a schedule developed for further identification in the other states.

Moyle and his group also helped bring to date Dilldown climatic and streamflow compilations.

## MOUNTAIN STATE RESEARCH CENTER

During the late summer and early fall, this section of West Virginia had two heavy rainfalls as by-products of hurricane activity. They were unusual enough that bridges were washed out, communities cut off, and several towns isolated for a day or longer.

These rains were a good test of road layout and maintenance recommended as a result of studies on the Fernow. Inspections immediately after each rainfall showed that wherever roads had been put in according to our standards, erosion was at a minimum. Old type road construction did not hold up in critical spots. In many instances old type roads cannot even be reconstructed at the same location.

Weitzman, assisted by Dick Jones and Gil Varney, spent three days in New York teaching road layout, construction and maintenance, at a school called by Region 7. The school was essentially designed for foresters engaged in the small watershed program.

Lull visited us in February, bringing a heavy snowstorm. He and Fridley floundered around the gage network recording snow depths and water contents, and an early-morning temperature of  $-14^{\circ}$  F.

### Addenda

Weitzman attended the Allegheny Section, SAF meeting in Pittsburgh. The theme of the meeting was watershed management. Sid presented a paper, "Management of Forests for Water Conservation."

Burley Fridley is maintaining records at the Fernow while we wait for a replacement for Trimble. Apparently men of Trimble's calibre are hard to find.

Carl Barr addressed the Eastern Maine Forest Forum. He talked on skid road location and construction.

A representative of the Virginia Forest Service brought a logger and a landowner to the Fernow to negotiate terms and methods based on our research results.

Paul Shull of the Armstrong Paper Company visited the Fernow and inspected our logging road studies. He plans to have his staff down this summer or fall.

The Fernow staff is now using their new office building recently completed at the nursery.

## WHITE PINE-HARDWOOD RESEARCH CENTER

Selecting the new experimental area for watershed management studies in New Hampshire began in the latter part of August, but the final choice was not made until late in September. The area chosen is the Hubbard Brook watershed, a tributary of the Pemigewasset River. It flows into the Pemigewasset from the west at West Thornton, which is a small community 13 miles north of Plymouth, New Hampshire. This research watershed, which is part of the White Mountain National Forest, covers about 7500 acres. The main stream flows in a west-east direction and has enough permanent flow tributaries draining both the north and south slopes to make it suitable for watershed studies. The watershed is completely forested--mostly with northern hardwoods, but with some spruce-hardwoods and scattered patches of spruce and fir. The original stand was logged about 40 years ago, and there has been little cutting since then. Soils on the watershed are shallow and bouldery.

Bob Pierce, the last man currently assigned to the new project arrived early in January. He came from the Vicksburg, Mississippi Infiltration Project. Sartz had reported on October 18, and Trimble on November 10.

### Preliminary work started

We do not yet have accurate, large-scale maps for the Hubbard Brook watershed. To remedy this situation, a special air-photo project was flown on November 10 by Forest Service personnel and airplane from the Beltsville Forest Insect Laboratory. We now have several sets of good contact prints at a scale of 1:7920 and also photo mosaics of the whole area.

Trimble and Sartz spent some time last fall scouting the area for a good road location and looking for good weir sites. We hope to get our first weir construction underway this spring.

### Logging Road Erosion Observations

The hurricanes of last fall helped focus attention on a problem which had not been considered too important here before: skidroad erosion. The heavy rains accompanying the hurricanes caused costly erosion damages on certain small areas. But further observations showed that severe erosion is not strictly a hurricane phenomenon in the White Mountains. Gullies four and five feet deep had developed on some skidroads before the hurricane rains of this year hit the area. These were caused by rapid runoff from melting snow. Where waterbars had been properly installed, however, soil loss was at a minimum. Obviously the granitic forest soils of the White Mountains are extremely erosive where the mineral soil has been exposed, and logging and skidroad erosion control is an important part of the forest management job in this area.

## Winter activities

Frost data have been taken for a number of years as part of the Station's forest influences program. These data have never been thoroughly organized and analyzed. Pierce is working on this now.

An exploratory snow study was begun early this year at Hubbard Brook to give us an idea of the seasonal snowfall pattern on the watershed. Four plots for each of the two major aspects (north and south) were laid out at elevation intervals of 500 feet from 1000 feet above sea level to 2500 feet. Snow depth and the water content have been measured on each of these plots at two-week-or-so intervals throughout the winter. The maximum peak in the snow pack came sometime in March. Maximum snow depth at the higher elevations was more than three feet, with a water equivalent of 10 to 12 inches. Variation by elevation was less than expected.

A working plan has been prepared and field measurements have begun on another snow study--this one at the Bartlett Experimental Forest. The purpose of this study is to determine the effects of northern hardwood forests on both the accumulation and rate of melt of snow. The Bartlett area was selected because the system of patch cuttings on the forest lends itself very well to this type of study. The effect of two different hardwood forest conditions is being studied, well-stocked pole timber, and old-growth sawtimber. Measurements of snow depth and water content are being made in small clearcut openings in each of these stands and in the surrounding forest. This study will be carried on for two or three years so that variations in annual snowfall will have had a chance to express themselves. Analysis of the measurements made so far shows that there is a considerable and highly significant difference between snow depths in the openings and in the stands surrounding them. Differences in water contents tend to be of a lower magnitude.

Our snow studies this year are also giving us "the feel" of this kind of work. They are showing us what kind of point-to-point variations we can expect in snow packs; and they are disclosing some problems inherent in snow surveying. One of the more knotty problems is how to measure the effect of forests on snow accumulation without confounding this with their effect on the rate of melt. We have found indications this winter, for example, that there had been some loss of water from the snowpack by melting even before the maximum accumulation was reached. During the build-up of the snow pack the forest canopy reduces net snowfall through interception. However, during melt periods the effect of the forest cover is just the opposite; it retards melting. Thus, unless great care is exercised in studying canopy effects, the results can easily be confused. This is especially true during late winter when the processes of snow accumulation and melt frequently alternate. Failure to differentiate between these two processes may be one reason why past studies of the effect of hardwood canopies on snow accumulation have given such conflicting results.

## Soil Survey Planned for Hubbard Brook

A cooperative agreement has been made with the Soil Conservation Service for assisting us in making a soil survey of our experimental watershed. A reconnaissance survey of the whole area will be made this summer. Detailed surveys of individual watersheds will begin next field season. Pierce will work with the SCS man on these surveys. SCS has a special interest in this project. For them it is a pilot plant study in which to work out systems of classifying and mapping forest soils for use in both timber management and watershed management work.

We have begun to accumulate some soils laboratory equipment. However, it will be some time before we have everything needed for a complete soils lab setup. In the meantime, the Agronomy Department of the University of New Hampshire has offered us the use of their facilities.

## Talks, Meetings, and other items

Howard Lull spent a week with us in the early part of February. He helped Pierce get started with the frost analysis, and went over with us our programs of work, and equipment needs. And we showed him what Hubbard Brook snow looks like.

Pierce and Sartz attended the Eastern Snow Conference meeting at Burlington, Vermont, February 10 and 11. They reported that it was a fine meeting but, ironically, they had to leave early because of a big snow-storm.

Trimble talked to both the New Hampshire Chapter of the S.A.F. and the New Hampshire Resources Planning Board on our watershed program at Hubbard Brook.

Sartz's paper, "Skidroad Erosion--a by-product of mechanized logging", has been submitted to the Northeastern Logger.

Trimble spent several days in the Garlan Brook watershed with personnel of the White Mountain National Forest, planning logging roads which would meet watershed management standards.

## PUBLICATIONS

Integrating Timber and Watershed Management in Mountain Areas  
by Sidney Weitzman and G. R. Trimble, Jr., Jour. Soil & Water Conservation  
10:70-75, March, 1955.

## DISCUSSION

Effect of a hardwood forest canopy on rainfall intensities.  
G. R. Trimble, Jr., and S. Weitzman. Trans. AGU: 35:226-234, 1954.

We agree with the Coweeta staff and their reference to Professor Kittredge's text that total interception of rainfall beneath a hardwood stand is greater in summer than in winter, even though substantiating data, cited by Kittredge, are by no means conclusive. Of the two studies he reports, one was very sketchily described and based admittedly on meager data; the other consisted of data the Southeastern Station has never published. In any case there is nothing in our paper which refutes this evidence.

Accepting this evidence does not change our finding that throughfall is reduced by canopy interception approximately the same amount in both summer and winter. If this surprises the Coweeta staff, they are joining good company: it surprised us - and apparently Professor Kittredge was surprised at the relative amounts of winter interception.... "... surprising fact is that during the winter deciduous forests without foliage intercept as much of the precipitation as they do."

Coweeta's opinion "... 5 gages at fixed positions and 59 storms cannot provide reliable average figures..." cannot be taken seriously. Differences in average intensities and throughfall were highly significant, a finding which could have well been obtained with even fewer data.

The points on unwarranted extrapolation, the irrational shape of our winter intensity reduction curves, our incorrect expression of the relation of interception rate to ground rainfall intensity, and the nature of the variance of our regression equations were well taken. The Coweeta interception data were interesting in that one of their two examples agreed with our findings.

After studying Coweeta's arguments as to the influence of the forest canopy on erosion, we cannot but acknowledge the points they make - but still consider their influence negligible. To check on this further, we are considering installing paired plots beneath a hardwood canopy, one plot undisturbed, and one with litter removed. The relative contribution towards erosion control of the canopy and litter should become evident. Along these lines, Dunford's data in the December Journal of Forestry are illuminating.

We appreciate Coweeta's comments and look forward to reading any of their findings on this subject.